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An Enumeration of the Lichens of Newfoundland and Labrador.

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The purpose of this paper is to present as full a list of all authenticated lichens that are to be found in the much unexplored regions of Newfoundland and Labrador, as has been afforded during a number of years' sojourn in these lands. The entire field of exploration has been the work of the untiring Rev. A. C. Waghorne, who has been located there through parochial work, and during such residence has endeavored to secure all such plants as it has been possible for him to obtain. The labor has been attended with many difficulties; the inconveniences for traveling, the character of the climate, and the ruggedness of the country have hindered and delayed him in his efforts. The general character of these plants may be regarded as sub-arctic; many, however, are strictly more boreal in distribution, while others are of more southern climes. The determination of these plants has been attended with some difficulty, owing to the great tendency to variation, depending in part on the nature of the climate, and the character of the substratum. The entire work has been subject to my supervision, and a number of the more difficult species, as well as some new types (particularly in the Lecanorei and Lecidacei), have been under the kind observation of Dr. F. Arnold, of Munich, and Dr. J. Hulting, of Norrkoping. A few species are regarded as new and these will be described. The list embraces a large number of types common to both hemispheres.

Most of the lichens of Newfoundland and Labrador were collected from the following localities: Trinity Bay, on the southeastern coast; others from Notre Dame Bay, and a few from White Bay, further north from Placentia Bay to the Labrador. On the Labrador the collection was principally made in the Straits of Belle Isle, then along the coast from Battle Harbor north to Seal Islands, and thence about Sandwich and Gross waters to Hamilton Inlet.

RAMALINA Ach.

R. calicaris (L.) Fr.

Var. *canaliculata* Fr.

Var. *farinacea* Schaer.

R. intermedia Del.

Thallus whitish, pale straw color and glaucescent, erect, dichotomously branched, divided and the apices attenuated and divided with frequent soredia on the edges, the cortical layer more filamentous. Apothecia terminal, subtended by elongated forked extremities of the lacinia, pale yellow. Spores hyaline, ellipsoid uniseptate.

R. rigida (Pers.) Tuck.

R. pusilla Prev.

Var. *geniculata* Tuck.

R. minuscula Nyl. (*Alectoria minuscula* Nyl.)

Thallus densely entangled, small and quite scabrous, apothecia not seen in our specimens. A plant closely allied to *R. pusilla* Prev. from which it distinctly differs.

R. polymorpha Ach.

R. pollinaria Ach.

R. pollinariella Nyl.

Thallus small and finely divided, mostly sorediferous, erect, pale straw color. Plants generally sterile. *R. minuscula. f. pollinariella* Nyl.

CETRARIA Ach.

C. muricata Ach.

Thallus smaller than in the following species, more densely intricate and caespitose, compactly ramulose, terete to subterete, and frequently compressed, smooth, shortly branched, the branches becoming spinulose at the apices.

C. aculeata Ach.

C. Richardsonii Tuck.

C. arctica Hook.

C. odontella Ach.

C. Fendleri Tuck.

C. commixta Nyl.

Thallus clear bright brown to fuscescent, smooth, irregularly laciniate, divided; laciniae erect, much entangled, plane, the margins not elevated, apices obliquely furcate, uniform in color, beneath paler; apothecia reddish brown, disk rugose, margin granulose; spores simple, hyaline, oblong, $\frac{9-11}{4-5}$ mic.

C. Fahlunensis (L.) Schr.

C. Islandica (L.) Ach.

Var. *crispa* Ach.

Var. *Delisaei* Borr. (*C. hiascens* Th. Fr.)

C. ciliaris Ach.

C. lacunosa Ach.

C. nivalis Bell.

C. aureus Tuck.

C. glauca (L.) Ach.

Var. *fusca* Fl. Thallus brown and dark.

C. juniperina L.

Var. *Pinastri* Ach.

Var. *terrestris* Schr.

C. saepincola Ehrh.

C. saepincola var. *chlorophylla* Wahl.

EVERNIA Ach.

E. prunastri (L.) Ach.

USNEA Ach.

U. barbata (L.) Fr.

Var. *ceratina* Schr.

Var. *hirta* Fr.

F. *strigosa* Ach.

Var. *florida* Fr.

F. *glabrescens* Nyl.

Var. *dasypoga* Fr.

Var. *plicata* Fr.

U. longissima Ach.

U. trichodea Ach.

U. cavernosa Tuck.

ALECTORIA Ach.

A. divergens (Ach.) Nyl.

A. jubata L.

Var. *implexa* Fr.

Var. *chalybeiformis* Ach.

Var. *bicolor* Fr.

Var. *prolixa* Ach.

A. capillaris (Ach.) Nyl. (*A. jubata* var. *cana* Ach.)

Thallus pale, hoary to yellowish-rufescent, much elongated and frequently branched; branches flaccid, densely entangled and somewhat compressed, angular, lacunose beneath; apothecia unknown.

A. ochroleuca (Ehrh.) Nyl.

Var. *rigida* Fr.

Var. *osteina* Nyl.

Var. *nigricans* Ach. (*A. nigricans* Nyl.)

Var. *circinata* Fr.

Var. *sarmentosa* Nyl.

THELOSCHISTES Norm.

T. chrysopthalmus (L.) Norm.

T. parietinus (L.) Norm.

Var. *aureola* Ach.

Thallus brighter yellow to orange, rounded, lobate, sinuately incised, thicker, crenate, the margins erect, granulate; apothecia sub-crenate.

T. lychneus Nyl.

T. polycarpus Ehrh.

Var. *pygmaeus* Fr.

T. concolor Dicks. (*Xanthoria candelaria* Nyl.)

PARMELIA Ach.

P. aurulenta Tuck.

P. tiliacea (Hoff.) Flk.

Var. *sublaevigata* Nyl.

P. cetrata Ach.

P. Borreri Turn.

Var. *rudecta* Tuck.

P. saxatilis (L.) Fr.

P. saxatilis var. *panniformis* (Ach.) Schr.

P. saxatilis var. *sulcata* Nyl.

P. saxatilis f. *furfurascens* Schr. Thallus very furfuraceous.

P. saxatilis var. *omphaloides* Fr.

P. fraudans Nyl.

This has been regarded as a subspecies of *P. saxatilis* and frequently taken for that species, but has distinctions worthy of specific rank.

P. physodes (L.) Ach.

Var. *vittata* (L.) Ach.

Var. *enteromorpha* Tuck.

Var. *obscurata* Ach.

P. encausta (Sm.) Nyl.

P. encausta var. *alpicola* Nyl.

P. colpodes (Ach.) Nyl.

P. olivacea (L.) Ach.

P. olivacea var. *aspidota* Ach.

P. olivacea var. *panniformis* Nyl.

P. olivacea var. *sorediata* (Ach.) Nyl.

P. lanata (L.) Wallr.

P. stygia (L.) Ach.

P. conspersa (Ehrh.) Ach.

P. leucochlora Tuck.

P. centrifuga (L.) Ach.

P. incurva (Pers.) Fr.

P. ambigua (Wulf.) Ach.

Var. *albescens* Wahl. (*P. hyperopta* Ach.).

Physcia DC.

P. hypoleuca (Mull.) Tuck.

P. comosa Esch. (*P. galactophylla* Willd).

P. leucomela (L.) Michx.

P. ciliaris (L.) D. C.

P. ciliaris var. *crinalis* Schr.

P. aquila var. *detonsa* Tuck.

P. pulverulenta (Schreb.) Nyl.

P. pulverulenta var. *leucoleiptes* Tuck.

P. pulverulenta f. *muscigena* Auct.

P. stellaris L.
P. stelloris f. *adscendens* Fr.
P. astroidea (Fr.) Nyl.
P. tribacia (Ach.) Tuck. (*P. erosa* Borr.)
P. hispida Schreb. (*P. tenella* Ach.)
P. crispa (Bers.) Nyl.
P. caesia (Esch.) Nyl.
P. obscura (Ehsh.) Nyl.
Var. *endochrysea* Nyl.

UMBILICARIA Hoff.

U. rugifera Nyl.
U. cylindrica (L.) Del.
U. proboscidea (L.) Sten.
U. arctica Ach. (*U. proboscidea* v. *arctica* (Ach.) Tuck.)
U. anthracina (Wulf.) Schr.
U. polyphylla (L.) Hoff.
U. flocculosa Hoff.
U. hyperborea Hoff.
U. erosa (Web.) Hoff.
U. Muhlenbergii (Ach.) Tuck.
U. hirsuta (Ach.) Sten.
Var. *grisea* Th. Fr.
U. vellea (L.) Nyl.
U. Pennsylvanica Hoff.
U. spodochroa Ehrh.

Thallus varying from moderately large and irregular to small and orbicular, thin, flattish and spreading, with an irregular waving crenate margin in the smaller forms, pale ashy to light purplish brown in older specimens, paler at the centre and mealy; beneath brown and minutely granulose and thickly covered with irregular stout brownish fibrils; apothecia very numerous, sessile and scattered towards the border, elevated, stout and robust, orbicular, disk prominent, rounded and conspicuously papuloid, surrounded by a thick, even or fissured margin, smooth, black; spores ellipsoid, simple, $\frac{16-23}{8-14}$ mic.

The occurrence of this Scandinavian lichen in this country is rather remarkable.

U. pustulata (L.) Hoff.
Var. *papulosa* Tuck.

U. LABRADORENSE Hulting n. var.

Thallus thinner than the preceeding, small, from ash color becoming olivaceous or brown, rugulose, papulose, papules scattered, remotely prominent, beneath finely granular, foveolate, foveoli small, contracted, sanguineous within; apothecia reddish-brown, orbicular with a well raised margin 1–2 mm. broad; spores large, orbicular $\frac{80}{45}$ mic. On rocks associated with the preceding variety. Labrador.

STICTA Schreb.

S. amplissima (Scop.) Mass.
S. herbacea (Huds.) Ach.
S. pulmonaria (L.) Ach.
S. querizans (Michx.) Ach.
S. limbata (Sm.) Ach.; evidently quite new to this region.
S. aurata (Sm.) Ach.
S. scrobiculata (Scop.) Man.

NEPHROMA Ach.

N. arcticum (L.) Fr.
N. expallidum Nyl.
N. laevigatum Ach.
Var. *parile* Nyl.
N. Lusitanicum Schr.

PELTIGERA Willd.

P. venosa (L.) Hoff.
P. apthosa (L.) Hoff.
P. polydactyla (Neck.) Hoff.
P. rufescens (Neck.) Hoff.
P. pulverulenta (Tayl.) Nyl. (*P. scabrosa* Th. Fr.)
P. malacea (Ach.) Fr.
P. canina (L.) Hoff.
Var. *spuria* Ach.
Var. *sorediata* Schr.
Var. *spongiosa* Tuck.

SOLORINA Ach.

S. crocea (L.) Ach.
S. saccata (L.) Ach.

PHYSMA Mass.

P. luridum Mont. A single specimen found.

PANNARIA Del.

P. hypnorum (Hoff.) Koerb.

P. lanuginosum (Ach.) Koerb.

P. rubiginosa (Thunb.) Del.

P. leucosticta Tuck.

P. brunnea (Sw.) Mass. (*P. pezizoides* Sw.)

P. microphylla (Sw.) Del.

P. lepidiota Th. Fr.

P. tryptophyllum (Ach.) Man.

P. carnosa Dicks.

P. WAGHORNEI n. sp.

Thallus thickened, congested and irregular, fissured, conglomerate, coarsely granulate, rugulose, from reddish brown to purplish and seated upon a thin limiting hypothallus; apothecia scattered but frequently conjoined, small, rounded and erect, and at length flat, with a prominent margin, from pale reddish to rufescent; spores ellipsoid, simple, $\frac{18-22}{7-8}$ mic.

On turfy earth. Evidently a distinct and well marked species, and not closely related to any other.

P. plumbea (Leight.) Del.

COLLEMA Hoff.

P. melaenum Ach.

P. flaccidum Ach.

LEPTOGIUM Fr.

L. lacerum (Sw.) Fr.

L. tremelloides (L.) Fr.

Var. *cyanescens* Ach. (*Collema cyanescens* Schaer.)

PLACODIUM DC.

P. elegans (Link.) DC.

P. murorum (Hoff.) DC.

F. *miniatum* Hoff. Thallus fulvescent, punctate; apothecia bright.

P. cirrochroum (Ach.) Hepp.

P. aurantiacum (Leight.) N. H.

P. cerinum (Hedw.) N. H.

Var. *pyraceum* Nyl.

F. *pyrithromum* Ach. Thallus gray to brownish, more or less rugulose; apothecia small, sunken and concave, pale green to buff-colored. Spores $\frac{10-14}{6-9}$ mic.

P. crenulatum Wahl.

P. citellinum (Ehrh.) N. H.

Var. *aurellum* Ach.

LECANORA Ach.

L. rubina (Vill.) Ach.

L. muralis (Schrb.) Schr.

Var. *Garovaglii* Anzi.

Var. *saxicola* Scur.

L. pallida (Schrb.) Schr.

L. sordida (Pers.) Th. Fr.

L. atra Huds.

L. dispersa (Pers.) Nyl.

L. badia (Pers.) Ach.

L. Hageni Ach. (*L. umbrina* Mass.)

F. *zostericola* Nyl.

L. subfusca (L.) Ach.

Var. *hypnorum* (Wulf.) Ach.

Var. *argentata* Ach. (*L. campestris* Schr.)

Var. *atrynea* Ach.

Var. *coilocarpa* Ach.

Var. *distans* Ach. (*L. chlarona* Ach.).

F. *rugosa* Pers.

L. symmictera Nyl.

Closely allied to *L. varia* v. *symmicta* Ach., but differs as to the reaction. K–C. orange.

L. atrosulphurea (Wahl.) Ach.

L. OCHRACEORUBESCENS Arnold n. sp.

Thallus scattered, elevated, roundish or irregular, greenish or yellow, granular, granules at length becoming tortulose and distinct; apothecia prominent, elevated, biatorine, sessile and finally conglomerate, proper margin depressed or quite wanting, brownish green to olivaceous with a delicate bloom, spores ellipsoid

hyaline, $\frac{9-14}{6-8}$ mic. On sandstone. This species is closely related to *L. Swartzii* Ach.

L. varia (Ehrh.) Nyl.

Var. *symmicta* Ach.

Var. *intricata* Nyl.

Var. *saepincola* Fr.

Var. *polytropa* Ehrh.

F. *illusoria* Ach.

Thallus evanescent, thin, apothecia dispersed, infrequent, large, disk plane, frequently convex, pale yellow, margin frequently obliterated.

L. ventosa (L.) Ach.

L. elatina Ach.

Var. *ochrophoea* Tuck.

Var. *minor* Tuck. (*Haematomma Cismonica* Belt).

L. pallescens (L.) Schr.

Var. *rosella* Tuck.

L. tartarea (L.) Ach.

F. *leprosa* Nyl.

F. *telephoroides* Th. M. Fr.

F. *grandinosa* Ach.

F. *macrocarpa* Th. Fr.

L. cenisia Ach.

L. cinerea (L.) Somf.

Var. *laevata* Fr.

L. calcarea (L.) Somf.

L. CINEREO–RUFESCENS (Ach.) Eck.

Thallus dark ashy white, paler towards the border, verrucose to areolate, rimose; hypothallus black; apothecia sunken in the thallus, convex, disk dark brown, bordered by an entire thalline margin; spores hyaline, ellipsoid, simple, $\frac{12-24}{7-10}$ mic. On rocks.

L. CAESIO–CINEREA (Nyl.) Eck.

Thallus ashy white to darker, thick, verrucose, areolate, broken; apothecia sunken in the areoles, concave, terminating in a white thalline border which finally becomes more or less prominent; spores hyaline, oblong, simple, $\frac{23-35}{12-15}$ mic. On rocks.

L. gibbosa Nyl.

L. fuscata (Schr.) Th. Fr.

Var. *rufescens* Th. Fr.

L. glaucocarpa (Wallr.) Ach.
F. *distans* Arn.
L. privigna (Ach.) Nyl.

RINODINA Mass.

R. sophodes (Ach.) Nyl.
R. turfacea (Wall.) Nyl.

PERTUSARIA DC.

P. bryantha (Ach.) Nyl.
P. velata (Turn.) Nyl.
P. panyrga (Ach.) Th. Fr.
P. multipuncta (Turn.) Nyl.
P. dactylina (Ach.) Nyl.
P. rhodocarpa Koerb.
P. communis D. C.
F. *rupestris* D. C.
P. leioplaca (Ach.) Schr.
P.laevigata (Nyl.) Arn. (*P. leioplaca* var. *laevigata* Th. Fr.)
P. subobducens Nyl. (*P. glomerata* Schr.)
P. protuberans Smf.
P. globularis Ach.

URCEOLARIA Ach.

U. scruposa (L.) Nyl.
Var. *bryophila* Esch.

THELOTREMA Ach.

T. lepadinum Ach.
T. subtile Tuck.

STEREOCAULON Schr.

S. coralloides Fr.
S. paschale (L.) Fr.
S. denudatum Fl.
S. condensatum Hoff.
S. tomentosum Th. Fr.
S. alpinum (Th. Fr.) Laur. (*S. tomentosum* var. *alpinum* Th. Fr.)
S. pileatum Ach.
S. nanodes Tuck.

PILOPHORUS Th. Fr.

P. cereolus Ach.
Var. *fibula* Tuck.

CLADONIA Tuck.

C. symphicarpa Fr.
Var. *epiphylla* (Ach.) Nyl.
C. cariosa (Ach.) Spreng.
C. decorticata Flk.
C. pyxidata (L.) Fr.
Var. *simplex* Hoff.
F. *costata* Fl.
Var. *pocillum* Ach.
C. fimbriata (L.) Fr.
Var. *tubaeformis* Fr.
Var. *radiata* Fr.
C. degenerans Fl.
C. gracilis (L.) Nyl.
Var. *verticillata* Hoff.
Var. *verticillata* f. *phyllophora* Ehrh.
Var. *hybrida* Schr.
Var. *elongata* Fr.
F. *macroceras* Tuck.
F. *chordalis* Tuck.
F. *amaura* Fl.
F. *aspera* Fl.
C. cornuta (L.) Fr.
C. turgida (Ehr.) Hoff.
Var. *conspicua* (Ach.) Nyl.
C. papillaria (Esch.) Hoff.
C. cenotea (Act.) Schs.
Var. *furcellata* Fr.
C. squamosa Hoff.
F. *turfacea* Rehm.
F. *ventricosa* Fr.
F. *densicollis* Hoff.
F. *asperella* Flk.
C. furcata (Huds.) Fr.
Var. *crispata* Fl.

Var. *racemosa* Fl.
Var. *subulata* Fl.
Var. *squamulosa* Schr.
Var. *adspersa* Fl.
C. rangiferina (L.) Hoff.
C. sylvatica L.
Var. *alpestris* L.
C. Botrytes (Hag.) Hoff.
C. carneola Fr.
Var. *cyanipes* Somf.
C. amaurocraea (Fl.) Schr.
C. uncinalis (L.) Fr.
Var. *adunca* Auct.
Var. *Caroliniana* Tuck.
Var. *turgescens* Fr.
C. Boryi Tuck. (*C. lacunosa* Bory.)
C. chlorophæa L.
F. *simplex* Hoff.

C. MULTIBRACHIATA (Fl.) Eck.

Thallus ashy brown, squamulose, mealy; podetia erect, slender, mostly smooth with repeated proliferations or branches, pervious; spores curved, $\frac{6-7}{1-3}$ mic. This plant is somewhat allied to *C. Floerkeana* Fr., from which it is not easily separated, but considered by Dr. Arnold as distinct.

C. Floerkeana Fr.
C. cristatella Tuck.
Var. *ochrocarpia* Tuck.
C. pulchella Schw.
C. macilenta (Esch.) Hoff.
F. *clavata* Ach.
C. digitata Fl.
F. *brachytes* Ach.
F. *monstrosa* Ach.
C. deformis (L.) Hoff.
C. coccifera L. (*C. cornucopioides* (L.) Fr.)
F. *pleurotica* Ach.
C. bellidiflora (Ach.) Schr.
Var. *Hookeri* Nyl.

THAMNOLIA Ach.

T. vermicularis (Sw.) Schr.

BAEOMYCES Fee.

B. aeruginosus Scop.

B. byssoides (L.) Schr.

B. roseus Pers.

Var. *fungoides* (Sw.) Ach. (*Sphyridium fungiformis* Scop.)

BIATORA Fr.

B. granulosa (Esch.) Poetch.

Var. *escharoides* Esch. Thallus very minutely granulose, yellow or ashy white; apothecia confluent, diffiform, strongly convex and immarginate, dark brown to reddish chestnut; spores simple, $\frac{9-16}{4-6}$ mic. On clay soil.

B. coarctata Sm.

Var. *clascista* Ach.

Thallus white or greyish, very thin, leprous and effuse, apothecia sessile, quite innate, concave or plane with a well defined prominent white coarctate margin. Spores similar.

B. flexuosa Fr.

B. russula (Ach.) Mont.

B. cinnabarina (Somf.) Fr.

B. vernalis (L.) Fr.

Var. *helvola* Koerb.

B. sanguineo-atra (Fr.) Tuck. Spores about $\frac{10-18}{5-9}$ mic.

B. Berengeriana Nyl.

This plant is allied to *B. sanguneo-atra* Fr. but may be readily distinguished by the absence of violet or bluish granules found among the paraphyses in that species. Spores $\frac{12-18}{4-5}$ mic.

B. rufo-fusca Anzi.

B. turgidula Fr.

B. rivulosa (Ach.) Fr.

B. ARCUATULA (Arn.) Eck.

Thallus flat and thickened, areolate, rimulose, olivaceous to fuscescent; apothecia brownish-black to very black, margin elevated concolorous and shining, epithecium brown, spores hyaline, simple, 2–4-guttate, somewhat curved and obtuse at the apex, $\frac{12-14}{3-4}$ mic. A species closely related to *B. rivulosa* (Ach.) Fr. On rocks.

B. SCRUPULOSA n. sp.

Thallus of thickened coalesing granules, areolate, rimulose, pale olive to yellowish brown, areoles adnate, contiguous, mingling into a continuous uneaven crust; apothecia scattered, diffiform, erect, black, plane and somewhat depressed, surrounded by a tortulous erect concolorous margin; spores simple, broadly ellipsoid, hyaline, $\frac{8-9}{5-6}$ mic. A well marked species which seems to approach *B. Kochiana* Hepp.

B. ALBO-FUSCESCENS (Nyl.) Eck.

Thallus thinly diffused and even over the surface, plane and slightly granular or furfuraceous, or at length quite smooth and glaucous; epithecium pale; apothecia very sparse, rounded and elevated, at length flat; disk brown and prominent, reddish, margin elevated. Spores ellipsoid, pointed, $\frac{9-11}{4}$ mic. On rocks.

B. mollis Wahl.

B. Nylanderi Anzi.

B. uliginosa (Schr.) Fr.

B. varians Ach. (*B. exigua* Chaub.)

B. mixta Fr. (*B. tricolor* Nyl.)

B. Laureri Hepp.

B. Heeri Hepp. Parasitic on *Solorina saccata.*

B. STEREOCAULORUM (Th. Fr.) Eck. (*Biatorina* Lich. Miquelon, Arnold.) Thallus mostly wanting; apothecia very small, black, plane; epithecium brown, hymenium colorless to bluish, paraphyses loosely disposed; spores hyaline, bilocular, 8 in thekes, $\frac{15}{18}$ mic. Parasitic on *Stereocaulon alpinum.*

B. sphaeroides Dick.

B. hypnophila Turn.

B. artyta Ach.

B. rubella Esch.

B. RUPESTRIS (Sch.) Eck. Thallus cinerascent, thin and closely adnate, apothecia flat, innate, smooth, rufescent with a raised margin around the sunken disk. Spores immature. On rocks.

B. muscorum Sw.

B. umbrina Ach.

B. OBSCURATA (Sm.) Eck. Thallus composed of minute pale ashy to white rugose granules; apothecia minute, rounded and flat, dark brown to black, smooth and shining with a receding margin, very numerous. Spores broadly ellipsoid 4-locular, $\frac{15-16}{4-4\frac{1}{2}}$ mic. On dead moss.

B. PALLIDA (Arn.) Eck.

Thallus thin, chinky and minutely granulose, sparsely scattered over a thin but even surface, yellowish brown to fuscous; apothecia small, rounded, black, prominent, slightly flattish or convex, with a concolorous thalline margin; hypothallus mostly wanting. Spores fusiform, 6-locular, $\frac{36-39}{2-4}$ mic. On smooth barks.

B. CAESIO-RUFA (Ach.) Eck.

Thallus thin, white, scattered irregularly, of rounded and closely adnate granules, but forming an even uniform crust; apothecia sessile, minute, quite black, turgid, and becoming flat, with a persistent regular elevated margin; spores mostly 4-locular, $\frac{24-28}{5-6}$ mic. On smooth barks.

HETEROTHECIUM Flot.

H. grossum Pers.

H sanguinarium (L.) Flot.

Var. *endorhoda* Th. Fr.

Var. *effusa* Ach.

H. alpina Ach.

H. porphyrites Tuck.

H. leucoxanthum (Spreng.) Mass.

H. pezizoideum (Ach.) Flot.

LECIDEA Ach.

L. panaeola (Ach.) Fr.

L. platycarpa Ach.

Var. *superba* Ach.

L enteroleuca (Ach.) Fr.

Var. *diasemoides* Nyl.

L fusco-atra L.

L fuscescens Somf.

L. polycarpa Fr.

Var. *declinans* Nyl. Thallus mostly crustaceous; hypothecium fuscous.

Var. *sublactea* Somf.

L. CRENULATA (Dicks.) Eck.

Thallus thin, evanescent, cinerascent to pale yellowish grey; apothecia black, plane and simple, naked, with a raised flexuous crenulate proper margin; spores ellipsoid, hyaline, simple, $\frac{45}{1-5}$ mic. On rocks.

L crustulata Ach.

Thallus pale to brownish or often grey, adnate, thin, tartareous effuse, subrimulose to areolate; apothecia numerous, dispersed, sessile and simple, black with a distinct thin margin; hypothecium swollen, nearly brown; spores 8 in the thekes, simple, oblong, $\frac{14-15}{7-8}$ mic. On rocks.

L albocoerulescens (Wulf.) Schr.

Var. *flavocoerulescens* Schr.

Var. *cinereoatra* Ach.

L. variegata Fr. (*L. pantherina* Th. Fr.)

L. macrocarpa D. C.

L. tessellata Fl. (*L. cyanea* Th. Fr.)

L. lapicida (Ach.) Fr.

L. leucothallina Ach.

L. empetrea Nyl.

L. tenebrosa Fl.

L. latypea Ach.

L. DISTANS n. sp.

Thallus thin, evanescent, but at length becoming minutely granulose and frequently continuous over a scurfy surface; apothecia mostly subsessile, elevated, large, flat, black with a depressed disk surrounded by a conspicuous granulose and crenate margin; disk covered by a delicate evanescent thin bloom; hypothecium pale; spores long, ellipsoid, simple, $\frac{12-14}{3-4}$ mic. On rocks. Labrador

L. contigua var. *meiospora* Nyl.

Thallus thin, ashy white, areolate, rimulose; apothecia black, plane, with a proper margin, disk somewhat pruinose, spores simple, hyaline, $\frac{11-16}{6-8}$ mic. On rocks.

L. Kochiana Hepp.

Thallus pale ashy brown to fuscescent, rimose, areolate, broken, areoles sunken, plane, bordered by a black margin; apothecia innate, black, immarginate, flexuous or slightly angulose, diffiform; disk plane, polished and smooth; spores 8 in the thekes, oblong, simple, $\frac{8-11}{6-8}$ mic. On rocks.

L. dispansa Nyl. (*L. expansa* Nyl.)

Thallus furfuraceous, rimulose, thin, black; apothecia very numerous, minute, sessile, scattered, black, plane, the margin very smooth; hypothecium thin, fuscous; epithecium hyaline; spores about 8 in the thekes, simple, ellipsoid, $\frac{10-12}{4-5}$ mic. On rocks.

L. auriculata Th. Fr.

L. sylvicola (Flot.) Nyl.

L. CONFERENDA (Nyl.) Eck.

Thallus verruculose, granulate, obscurely cinerascent; apothecia very small, black, convex and glaucous; spores oblong, simple, hyaline, $\frac{12-14}{3-4}$ mic. On rocks.

BUELLIA De Not.

B. capitulata Th. Fr. var. *erubescens* (Flot.) Eck.

Thallus of thin smooth flat discrete granules, becoming at length areolate; areoles irregular and evanescent at the outer margin; apothecia scattered, more or less sessile, small and very black, flat and bordered by a well raised margin; spores ellipsoid, bilocular, fuscescent, $\frac{18-19}{6-7}$ mic. On smooth barks.

B. PUNCTIFORMIS (Hoff.) Eck.

Thallus very thin, scurfy, minutely granular, grey or whitish, becoming at length nearly obsolete or with a delicate coloration; apothecia small, flat, granular and the disk quite rugose, brownish-black to very black, with a raised stout thick granular margin; spores bilocular, $\frac{12}{6}$ mic. On smooth barks.

B. albo-atra (Hoff.) Th. Fr.

B. parasema (Ach.) Fr.

B. disciformis Fr.

B. spuria Schr.

B. lepidastra Tuck.

B. myriocarpa D. C.

B. ATRATA (Sm.) Eck.

Thallus blackish to ashy brown, areolate, broken, areoles plane, small, smooth, convex, hypothallus black; apothecia springing from the hypothallus, usually innate, small, appressed, margin thin, entire; spores 8 in the thekes, bilocular, fuscous, $\frac{12-17}{7-10}$ mic. On rocks.

B. colludens Nyl.

B. EXCENTRICA (Nyl.) Eck.

Thallus brownish, white or gray, thin, sparingly more or less broken; apothecia pale, black, sessile, plane with a thickened obtuse margin. Spores $\frac{32-37}{15-22}$ mic., the cells murilocular.

B petraea (Flot.) Koerb.

Var. *grandis* Flk.

Var. *Montagnei* Tuck. (*B. atro-alba* Fr.)

F. *empetraea* Nyl.

B. CONIOPSOIDEUM (Hepp.) Eck.

Thallus consisting of scattered white irregular flat scales, which are diffused over a black hypothallus; apothecia arising from the hypothallus, sparingly scattered, black, flat and somewhat prominent, with a raised rugose margin; disk roughened and finely papillose; spores ellipsoid, 4-locular, $\frac{22-24}{7-8}$ mic. On rocks.

B. geographica (Fl.) Tuck.

B. pertusaricola Willey.

B. parmeliarium Somf.

B. saxatilis (Sch.) Koerb.

B. scabrosa (Ach.) Koerb.

B. OBSCURATA (Ach. Koerb.) Eck.

Thallus pale to fuscesent or rufofuscescent, thin, finally areolate, continuous, areoles plane, simple; apothecia black, naked, plane, sessile, innate or strongly adnate with a thicker obtuse pale margin; spores 8 in the thekes, ellipsoid, murilocular, $\frac{24-50}{10-40}$ mic. On rocks.

B. RIVULARIS (Flot.) Eck.

Thallus pale olive brown, areolate, diffiform, areoles flat upon a black hypothallus; apothecia large, flat, sunken in the areoles, black with a prominent raised waving margin; spores broadly ellipsoid, bilocular, fuscous, $\frac{30-33}{12-15}$ mic. On rocks.

B. COPELANDI (Koerb.) Eck.

Thallus composed of large irregular coarse whitish granules, becoming areolate, dispersed, seated upon a black hypothallus; apothecia large, black and prominent, more or less finely turbuculate, but becoming flattish and concave, with a persistent margin; spores ellipsoid, bilocular, fuscescent, $\frac{18-24}{9-12}$ mic. On rocks.

B. badioatra (Fl.) Schr.

B. CONCRETA (Koerb.) Eck.

Thallus minutely granulose, closely adnate, pale ashy to whitish, bordered by a flexuous hypothalline line; apothecia sessile, minute and innate, immarginate with a thickened brown border; spores ellipsoid, murilocular, $\frac{24-50}{10-40}$ mic. On rocks.

B. CALCAREA (Weis) Eck.

Thallus determinate, white, roundish, of mealy or tartareous granules, areolate, rimulose towards the centre, configurate at the border; apothecia large, black, innate, plane, bluish, pruinose, convex, surrounded by a white thalline margin, proper margin dark, persistent; spores ellipsoid to oblong, 4-locular, $\frac{18-20}{3-6}$ mic. On rocks.

B. RUBESCENS (Arn.) Eck.

Thallus very thin, white, uneven and broken up into areole-like flat scales; apothecia scattered, sessile, small, from flat to concave, with a prominent raised margin but frequently wanting, from reddish-brown to black; spores broadly ellipsoid, bilocular, $\frac{18-21}{3-6}$ mic. On smooth barks.

LECANACTIS (Esch. Kbr.) Tuck.

L. abietina Ach.

L. premnea Ach.

OPEGRAPHA (Humb.) Ach.

O. zonata Kbr.

Thallus rufous to ferruginous, thin, subtartareous, smoothish, covered by nnmerous yellow or pale whitish soredia, marked at the border by conspicuous thick erect dark lines forming the hypothallus; apothecia fuscous to black, scattered, sparse and sessile; spores hyaline, contracted, fusciform, pointed, $\frac{16-20}{2-3}$ mic. On rocks.

O. atra Ach.

O. vulgata Ach.

XYLOGRAPHA Fr.

X. opegraphella Nyl.

X. parallela Fr.

GRAPHIS Ach.

G. scripta (L.) Ach.

Var. *recta* Schr.

Var. *varia* Ach.

Var. *limitata* Schr.

Var. *pulverulenta* Pers.

F. *radiata* Leight.

F. *flexuosa* Leight.

F. *typographa* Willd.

ARTHONIA Ach.

A. radiata Pers.

Var. *Swartzoidea* Nyl.

A. spectabilis Fl.

A. punctiformis Ach.

A. patellulata Nyl.

A. raunidia Nyl.

SPHAEROPHORUS Pers.

S. fragilis (L.) Pers.
S. coralloides Pers. (*S. globiferus* (L.) D. C.)

ACOLIUM Fee.

A. tigillare (Ach.) D. N.

CALICIUM Ach.

C. subtile Fr.
C. turbinatum Pers.

ENDOCARPON Hedw.

E. miniatum (L.) Schr.
Var. *complicatum* Schr.
Var. *fulvofuscum* Tuck.
E. cinereum Pers.

SEGESTRIA Fr.

S. majusculum Nyl.

TRYPETHELIUM Ach.

T. virens Tuck.

SAGEDIA Mass. Kbr.

S. Cestrensis Tuck.
S. oxyspora (Nyl.) Tuck.

VERRUCARIA Pers.

V. maura Wahlb.

Thallus dark reddish or jet black, tumid, polished, areolae smooth covered with minute points; apothecia immersed and enclosed in the thallus, scattered, roundish; epithecium conspicuous, poriform; perithecium spreading at the base, internally black; spores oblong, simple, $\frac{12-16}{7-8}$ mic. On rocks.

V. epigaea Pers.
V. theliodes Smf.
V. bryophila Lonnr. (*Polyblastia*).
V. rimosicola Leight.

Thallus wanting; apothecia black, minute, sessile, rounded, shining and polished; perithecium entire, black; epithecium pori-

form; spores 8 in. the thekes, brown, oblong to linear, 4-locular, constricted, $\frac{15-20}{6-8}$ mic. Parasitic on *Buellia excentricum*.

PYRENULA Ach.

P. punctiformis Ach.
P. glabrata Ach.
P. lactea Mass.
P. thelaena (Ach.) Tuck.
P. nitidella Mull.

A Diatomaceous Deposit from an Artesian Well at Wildwood, N. J.

BY CHARLES S. BOYER.

An artesian well sunk recently at Wildwood, N. J., exhibits at certain depths diatomaceous deposits of unusual interest. Mr. Woolman, whose researches into the geology of artesian borings are well known, has sent me samples of earths with the request that I enumerate the diatoms found therein. The accompanying list includes specimens occurring in a bed from 78 to 180 feet deep, of which Mr. Woolman remarks in the annual report of the Geological Survey of New Jersey for 1893 (page 401) that "a corresponding clay bed does not exist beneath the beaches to the northward, if we may judge by the specimens of borings furnished from the various wells or by the records where no specimens were obtained. It was probably in some way associated with the deposits of the Delaware River delta in a somewhat recently past geological age, and before the present peninsula of Cape May was formed."

It is not the purpose of the present paper to give a list of the forms obtained from the entire series of the well boring which has reached the depth of 1245 feet, passing through beds apparently identical with the Miocene deposits noticed at Atlantic City and which have already been described, but as the fresh water forms are very numerous and as there are associated with them certain marine and brackish water species not heretofore noticed in North America, the enumeration of all the diatoms thus far seen at the depths of from 78 to 180 feet, is here given.

The occurrence of *Polymyxus coronalis* is of peculiar interest, as it has been hitherto considered as growing exclusively at the mouths of the Para and the Amazon. It is not a mere accidental form, but is abundant in the deposit in all its numerous variations. Several years ago I found one specimen in material from one of the Atlantic City wells, but supposed at the time that it might have been a waif cast upon the shore. As *Polymyxus* now flourishes only in warmer waters the conclusion must be reached that the Delaware River delta formed the deposit under conditions quite different from those existing at the present time. It is at any rate now extinct along the North Atlantic coast.

The nomenclature of the following list is based upon DeToni's Sylloge Algarum, except in a few cases.

Achnanthes Hudsonis Grun.

A. inflata (Kütz.) Grun.

A. subsessilis Ehr.

Actinocyclus Ehrenbergii Ralfs.

A. subtilis Greg.

Actinoptychus heliopelta Grun. forma minor.

Only one specimen has been noticed.

A. undulatus Ehr.

A. vulgaris Schum.

Amphora ovalis (Bréb.) Kütz. var. *gracilis* (Ehr.) V. H.

Aulacodiscus Argus Ehr.

Auliscus pruinosus Bail.

Biddulphia Rhombus Wm. Sm.

Brebissonia Boeckii (Kütz.) Grun.

I have noticed this form in material from the Saguenay River, Can.

Campylodiscus echeneis Ehr.

The habitat of this species is usually given as marine or brackish water. Van Heurck is the only authority, as far as I have noticed, who states that it occurs in fresh water. I have found several specimens in mud taken from a supply reservoir in Philadelphia, the water of which is drawn from the Schuylkill River.

Cerataulus laevis Roper.

Cocconeis placentula Ehr.

Coscinodiscus Argus Ehr.

C. excentricus Ehr.

C. fasciculatus A. Schm.
C. marginatus Ehr.
C. minor Ehr.
C. nitidulus Greg.
C. Oculus-Iridis Ehr.
C. radiatus Ehr.
C. subtilis Ehr.
Cyclotella Kützingiana Thw.
Cymbella affinis Kütz.
C. cistula (Hempr.) Kirchn.
C. cuspidata Kütz.
C. cymbiformis Ehr.
C. Ehrenbergii Kütz.
C. gastroides Kütz.
C. lanceolata (Ehr.) Kirchn.
C. tumida (Breb.) V. H.
Encyonema ventricosum Kütz.
Cystopleura (*Epithemia*) *Argus* (Ehr.) Kunze.
An abnormal form with flexuose outline has been noticed.
C. gibba (Ehr.) Kunze.
C. gibberula (Ehr?) Kunze.
C. Musculus (Kütz.) Kunze.
C. Musculus constricta (Bréb.) V. H.
C. Sorex (Kütz.) Kunze.
C. Zebra (Ehr.) Kunze.
Eunotia Arcus Ehr.
E. diodon Ehr.
E. impressa Ehr.
E. major (W. Sm.) Rab.
E. parallela Ehr.
E. pectinalis (Dillw?) Rab.
E. praerupta Ehr.
E. robusta Ralfs.
E. tetraodon Ehr.
E. triodon Ehr.
Gomphonema acuminatum coronatum Ehr.
G. Augur Ehr.
G. capitatum Ralfs.

G. geminatum (Lyngb.) Ag.
G. gracile Ehr.
G. lanceolatum Kütz.
G. olivaceum (Lyngb.) Kütz.
G. turgidum Ehr.
G. Vibrio Ehr.
Hyalodiscus stelliger Bail.
H. subtilis Bail.

HYDROSERA (TERPSINOE?) NOVAE-CAESAREAE Boyer n. sp.

At first sight this species might appear to be a variety of *Hydrosera* (*Triceratium*) *trifoliata* Cleve, but a close comparison will show that the two are distinct.

Triangular, sides concave, *angles broad at the base, equally divided* into three projections, surface *sparsely punctate*. In Cleve's species the angles are cuneate and the middle lobe or tooth is narrower than the two outer, while the punctae are quite evident except at the center of the valve. There is a marked difference in general appearance, the New Jersey form being much less robust than that from New Zealand. It is quite common in the deposit and is of interest, as there is no form similar to it except that from New Zealand with the exception of two specimens noticed by Mr. Heinrich Reis in clay found near Cold Spring, Long Island, which discovery, however, was antedated by that made in the Wildwood material. I have not seen Mr. Reis' specimens, which he identifies as *Triceratum trifoliatum* and do not know, therefore, whether the Wildwood and Cold Spring forms are identical.

Melosira granulata (Ehr.) Ralfs.
Navicula acrosphaeria Rab.
N. affinis Ehr.
N. Americana Ehr.
N. bicapitata Lagerst.
N. Bombus (Ehr.) Kütz.
N. Brebissonii Kütz.
N. columnaris Ehr.
N. Crabro (Ehr.) Kütz.
N. Dactylus Ehr.
N. Dariana A. Schm.
N. decurrens Kütz.
N. distans (W. Sm.) Ralfs.
N. elliptica Kütz.

N. Fischeri A. Schm.
N. formosa Greg.
N. gibba Ehr.
N. Hitchcockii Ehr.
N. humerosa Bréb.
N. Iridis amphirhyncus Ehr.
N. Kamorthensis Grun.
N. latissima Greg.
N. Lewisiana Grev.
N. Liber linearis (Grun.) V. H.
N. limosa Kütz.
N. Lyra Ehr.
N. major Kütz.
N. mesolepta Ehr.
N. mesolepta nodosa Ehr.
N. mesostyla Ehr.
N. nobilis (Ehr.) Kütz.
N. pachyptera Kütz.
N. permagna (Bail.) Edw.
N. peregrina (Ehr.?) Kütz.
N. placentula (Ehr.) Kütz.
N. polyonca Breb.
N. pusilla W. Sm.
N. rhomboides Ehr.
N. sphaerophora Kütz.
N. Smithii Bréb.
N. stauroptera parva Grun.
N. tabellaria Kütz.
N. termitina Ehr.
N. trinodis inflata Schultze.
N. viridis (Nitzsch) Kütz.
Nitzschia Campeachiana Grun.
N. cirumsuta (Bail.) Grun.
N. granulata Grun.
N. salinarum Grun.
N. scalaris (Ehr. ?) W. Sm.
N. Sigma (Kütz), W. Sm.
N. tryblionella maxima Grun.

Odontidium mutabile genuinum Grun.
Plagiogramma tessellatum Grev., rare.
Pleurosigma eximium (Thw.) Grun. and Cl.
P. Sciotoense Sulliv.
P. Spencerii (Quek.) W. Sm.
Polymyxus coronalis L. W. Bail.
Pseudauliscus radiatus Bail.
Pseudocunotia flexuosa (Breb.) Grun.
Rhaphoneis amphiceros Ehr.
R. Belgica Grun.
R. gemmifera Ehr.
R. Rhombus Ehr.
Stauroneis acuta W. Sm.
S. gracilis Ehr.
S. Phoenicenteron Ehr.
Surirella angusta Kütz.
S. biseriata (Ehr.) Bréb.
S. cruciata A. Schm.
S. crumena Bréb.
S. elegans Ehr.
S. Febigerii Lewis.
S. oblonga Ehr.
S. ovalis Bréb.
S. ovalis ovata (Kütz) V. H.
S. splendida Ehr.
S. striatula Turp.
S. tenera Greg.

SURIRELLA WOOLMANIANA Peticolas, n. sp.

Mr. Peticolas, who discovered several specimens, remarks that it differs from *S. Gemma*, of which I had at first considered it a variety, in " size, outline, areolation and the hyaline centre."

Valves broadly obovate, rounded at both ends; costae slightly twisted, not reaching the median line, thus forming a pseudoraphe broadening at the centre. Costae and intercostate striae much more robust than in *S. Gemma*. It somewhat approaches certain varieties of *S. striatula*.

Synedra delicatissima W. Sm.
S. investiens W. Sm.
Terpsinoe Americana (Bail.) Ralfs.

Tetracyclus emarginatus (Ehr.) W. Sm.
T. lacustris Ralfs.
Triceratium alternans Bail.
T. favus Ehr.
T. sculptum Shadb.

Of the above about 80 are exclusively fresh water forms, 47 exclusively marine, while the others are found in fresh water and brackish or in brackish and marine.

Preliminary Notes on Nelumbo lutea.

By Benj. Heritage.

(Plate 231.)

In August, 1890, being desirous of investigating the root growth of *Nelumbo lutea*, the late Isaac Burk, and self visited the mill-pond at Sharptown, Salem County, N. J., for that purpose.

There were about eight acres thickly covered with the species, which presented a most gorgeous sight.

We procured a boat, and after considerable research, we found a place at which the water was but a few inches in depth, over a very soft mud. He managed the boat, and seating ourself on its bottom, with an arm stripped to the shoulder we selected one of the large leaves which had a flower stalk in close proximity.

These we traced with the hand, down into the ooze, to their common point of attachment, which brought the arm up to the elbow in the mud. There we found a very dense cluster of fibrous roots which were loosened, but this did not release the plant; as there was a horizontal portion, the size of a finger extending from it in opposite directions. The truth then dawned upon us that this majestic plant is stoloniferous!

We traced this horizontal stolon or stem until we accidentally broke it, before reaching its termination in either direction. Its course was quite direct, and lay at a uniform depth of about one foot beneath the surface of the mud.

At short distances we encountered very many other similar subterranean vines or stolons—portions of other plants perhaps

lying mostly in the same plane and crossing the pathway of our plant at various angles.

Such as were above ours had to be severed in order to liberate the one we were in quest of. At varying distances we found other clusters of roots, from each of which a single, large, peltate leaf rose about two feet above the surface of the water, while in the axil of several of them there was a flower stalk as tall. At many of the nodes we found a branch, each of which we traced until it, like the main stem, was accidentally broken, except in two instances, in which we secured the growing points. Upon finding our plants disconnected with the earth at all points, after about four hours' assiduous labor, we carefully took it on board, rowed ashore, spread it out upon the grass, and with the miller's "ten-foot pole" accurately measured it. The main stem was forty-seven feet long, and the combined length of the branches forty-three; in all ninety feet! It was to us a revelation, and exceedingly interesting, but it would have been even more so had we succeeded in unearthing the *entire* plant which, as it lay upon the ground before us, proved itself to be an aquatic *vine* of gigantic proportions.

The internodes were smooth, dull-white and of a uniform size throughout the main stem; they were about half an inch in diameter and were furnished with seven large air passages arranged in a circle equi-distant from a small central one and the epidermis. They were plentifully supplied with spiral tissue which could be drawn out a quarter of a yard before complete separation took place. These internodes varied in length from two feet, which was the shortest one in the main stem to *five* feet three inches, the longest in our specimen. Those of the branches were much shorter and their diameter less. *Long* internodes insured the separation of the leaves so that they could fully develop without coming in contact with each other, and perhaps the nature of the soil favored their growth, in confirmation of which we have seen *Carex vestita* Willd., growing in compact soil with *stolons* only a few inches long, whereas in an open porous soil they sometimes exceed two feet in length between the plants.

The diameter of the nodes was considerably greater than that of the internodes and it was from these alone the roots originated.

Later examination has shown the roots to be arranged in six-usually-circular clusters placed side by side and extending completely around the node, those growing from the upper side of the node also follow the general law of root growth, *i. e., descend.*

In those examined the number in each cluster ranged from 14 to 21, averaging 110 roots at a node.

The branches occurred regularly at several consecutive nodes, but irregularly at others. They sometimes extended to the right and to the left alternately like those of a Cucurbitaceous vine; at an estimated angle with the main stem of about 60° upon an average.

During the course of our investigation, the queries arose whether those long internodes are perennial or survive but a single season? Whether the plantlet at each node has a permanent character or otherwise; and, if the former prove true, whether each node becomes the centre from which new growth radiates the following year?

We contemplated a further inquiry the succeeding spring, hoping to solve those questions; but, during the interval, our friend was stricken with paralysis and incapacitated for additional research, and the matter rested.

In November last and again a month later, in company with Chas D. Lippincott, we visited the locality to inquire into the winter status of the plant, as well as to determine more fully its method of growth; and perchance to throw some light upon the above questions. The results thus far obtained are here submitted.

We secured many specimens containing buds, but in every instance they were at or near the end of a stem or branch, and consisted of one or generally two tuber-like enlargements of the stem following each other consecutively. The internodes of these thickened stems had failed to develop longitudinally more than a few inches, while transversely their diameter was greatly increased. The general structure of the stem was maintianed in the tubers, and the leaf buds were invariably found at their ends—the nodes—which had undergone but a slight modification. The tubers obtained varied from three to eleven inches in length, and very closely resembled a banana in appearance, both in regard to shape

and proportions; except that the color was creamy-white, marked with purplish dots. They were generally somewhat flattened on the side from which the lateral bud grew at the next lower node, which might indicate that the growth was directed to the development of the bud at that point rather than into that portion of the tuber in line with and beyond it.

Their texture is crisp, and it cuts with that peculiar grating which we hear and feel while cutting a raw potato with a thick knife; and which is doubtless owing, as Prof. Halsted has shown with relation to the winter buds of trees, to the presence of large quantities of starch stored during the growing season, for the rapid development of the embryo leaves in early spring, before they are capable of assimilating their nourishment.

There are at least two kinds of buds shown at the tubers; First, lateral leaf buds, developed at the nodes; and secondly, terminal buds, which contain an embryo vine. They are not uniform in size; the largest of the former measured five and one-half inches in length, and consisted of a single petiole surmounted by an involute blade two inches in diameter; the whole completely enveloped by a whitish, brittle succulent sheath, the edges of which overlap.

We obtained some specimens in which growth had extended just beyond the full capacity of the sheath, and it had been torn completely asunder below the blade, both portions having turned black.

The severed part would doubtless have continued to envelop the blade, and it would have been carried up through the mud by the lengthening petiole—as the calyptra of Musci is borne up on the apex of the capsule—and when its office of protection shall have been fulfilled the unfolding leaf will cast it aside.

The terminal buds are shorter and thicker than the others, and include a portion of the future vine. An internode and node, together with its young leaf, are all well formed; also a growing point beyond, and, like the leaf buds, they are protected by a similar sheath.

We also obtained the black shrunken shells of old tubers, from which all the nutriment had been drawn, which, with contiguous portions of the vine, were lifeless.

The roots at the nodes, so far as observation has thus far extended, all die in the fall; but we found much vitality still existing in the nodes. Portions of the internodes were discolored, had lost their rigidity, and were dead; such might have grown early in the season, and were the first to die. Other portions appeared full of life, and their cells, as well as those of the nodes, were filled with starch grains; but not one of the many nodes examined exhibited a bud, except as above stated, those at or near the extremity of the vines. This absence of buds, and the dead roots, suggest the early dissolution of all parts of the plant except those last formed. Although other portions of this wonderful plant may survive the winter, yet if this prove true it is presumed that after growth re-commences in the buds of the tubers, the starch in the vines behind them will be utilized, after which they will probably die. Let investigation be directed to this, as well as to other points of interest.

The living buds are at the ends of the tubers. Back of the tubers we have a long vine in which starch is stored, and which contains no buds, and show no signs of further growth. From this it appears that both the vines and tubers after being fully developed serve merely to store nutritive materials, and to transmit them to the growing points.

We now behold this noble plant not only as a true aquatic, subterranean vine, but it is metamorphosed into a *migratory* vine. Why migratory? Simply because the next year's buds are so far removed from the location of those of the last. Just how far a plant removes its situation in a single season can only be determined by locating one in early spring, tracing it throughout its entire length in the fall, and noting the position of the next year's buds. Our specimen furnished ocular demonstration that this removal must have been more than forty-seven feet! Is this method of growth found in any other genus than *Nelumbo?* we ask for information. The annual character of the growth from each particular node is a most wise provision. If all those plantlets survived the winter, and became the centre from which new growth proceeded, there soon be an overcrowding; and none would have room to develop naturally when deterioration and extinction would eventually ensue.

We are here furnished with another illustration, among many seen on every side around us, of unmistakable evidences of perfected thought in their creation, each being peculiarly adapted to the position it holds in the divine economy.

I am indebted to Dr. Ida A. Keller for the accompanying drawings and explanation of figures.

MICKLETON, N. J., 1894.

Explanation of Plate 231.

I. Diagram of vine of *Nelumbo lutea* Pers.
St, St.—main stem 47 feet long.
X—unknown dist. to tubers with living buds—T.
X′— " " old tuber shells—O. T.

II. End of stem ¼ of natural size.
St.—unthickened stem.
St′—two tubers terminating the stem.
Sh.—remaining portions of sheaths (black).
B—terminal bud which will develop into a stem.
B′.—axillary bud (sheath which covered it removed).
L. B′.—leaf bud, subtending terminal bud. It has a sheath of its own, which has not been removed, is distinct from the sheath marked Sh. The former is not black, the latter is.
L. B′.—leaf bud, upper portion exposed by removal of sheath.
R—points from which roots will emerge, these arranged in groups as indicated in the drawing.
R′—dead roots showing their articulations.
P—petiole of the last leaf of the season (now dead).

III.—Cross section of vine, natural size.
A—air passage.

IV. Cross section of tuber, natural size (shows the flattening).

V. " " involute leaf bud enlarged.
A—air passage.

VI. Starch grains. The largest represented (′) being .0492×.0328 mm.

On the Carpels of Opulaster malvacea (Greene).

This species was originally described by Prof. Greene in Pitt. 2: 30, 1889, as *Neillia malvacea*, from specimens collected by the author himself at the north shore of Lake Pend d'Oreille, in Idaho. In the diagnosis of the species it is referred to a section of the genus characterized by indehiscent carpels.

Recently I had occasion to investigate the fruit characters of this *Opulaster* and find that the carpels do rupture along well-defined sutures, although it takes place tardily. The fruit of the species is usually 2-carpellary, very rarely 3-carpellary. Each carpel is from 1–3-ovuled, developing as many or fewer seeds; the usual number is 1 or 2. At maturity the carpel is nearly triangular, much flattened, not at all inflated, and when well developed it measures about 4.5 mm. in length, and 3.5 mm. in width across the broadest portion. The seeds are oblong, somewhat compressed, nearly 2 mm. long and 1.3 mm. wide, grayish in color, with a firm polished testa and extremely bitter taste. The two carpels seen together bear a great deal of resemblance to the silicle of a *Lepidium* as Prof. Greene notes.

The carpels are connate except at the divergent apices. They usually separate along a lateral line at maturity. Occasionally this line of demarcation does not form and they remain united. The pedicels commonly fall away from the axis of inflorescence in autumn or early winter by the development of a constriction at their bases, carrying the unopened fruit with them. The dehiscence of the carpels does not usually occur until after they reach the ground, but if the pedicels are not detached from the axis of the corymb in the fall, which sometimes happens, the carpels will rupture in the spring while retaining their original position and enfolded by the persistent calyx.

The dehiscence of the carpels takes place along two sutures, a ventral and a dorsal. In the majority of the cases that have come under my observation the inner or ventral suture opens first, the fissure beginning near the apex or at the point of juncture of the carpels, and is complete from base to summit. The outer or dorsal suture opens immediately after the rupture of the inner, but the line of dehiscence extends across the top of the carpel only. Owing to this circumstance the carpel is never two-valved in dehisence, apparently a new character in our North American *Opulasters*, and therefore, clearly, to be considered as follicular. When the carpels are so firmly united that no lateral separation between them takes place the inner suture opens through both simultaneously.

JOHN B. LEIBERG.

HOPE, IDAHO, March 9th, 1895.

Two new mountain Plants.

By Merritt Lyndon Ffrnald.

Aster Hendersoni n sp.

Stem slender, 3 or 4 feet high, cinereous-pubescent, almost lanate, except toward the glabrate base, branching above the middle, the densely cienerous branches bearing single terminal heads, or themselves divided into naked or scarcely leafy branchlets; leaves thin, cinereous on both surfaces, especially on the mid-rib, or becoming glabrate above, the entire margins often ciliate; the upper cauline oblong or oblong-lanceolate, 2 or 3 inches long, with auricled clasping bases, the lower oblanceolate, conspicuously narrowed above the clasping bases, 4–6 inches long; leaves on the branchlets few, scarcely an inch long, often so few as to give the appearance of almost naked peduncles; heads large, an inch or two across, 4–6 lines high; involucre of two or three loose rows of cinereous linear-attenuate bracts, mostly herbaceous, but the inner sometimes scarious below, rarely with one two narrow foliaceous bracts; the fifty or more blue rays ½–¾ inch long, a line wide.

Collected by Prof. L. F. Henderson (No. 2798) in rich moist meadows along the St. Maries River, Kootenai county, Idaho, August 5, 1894.

Closely related to *puniceus* and *Cusickii*. The involucre is like the former, but the plant is more slender, with no trace of the stiff pubescence and harsh serrate leaves of that species, while the lower cauline leaves are contracted above the clasping bases as in *Cusickii*. *Hendersoni* has the same pubescence as *Cusickii* var. *Lyalli* Gray, but this latter plant has much broader leaves, and the outer bracts of the involucre are very broad and foliaceous, and, according to Prof. Henderson, it grows in more open and drier bottoms than the plant here described.

Carex scabrata × crinita n. hyb.

Either stout or slender, the leaves and culm harsh as in *scabrata;* spikes 5–7, mostly androgynous, varying from ⅓ to 1½ inches in length, the upper nearly sessile, the lower on peduncles an inch or more long, slightly spreading; scales lanceolate or ovate-lanceolate, with brown scarious margins, and strong green mid-veins sometimes continued into rough awns 2–3 times as long as the perigynia, sometimes not equalling the perigynia; perigynia broadly ovate, with the few nerves either obscure or well

marked, some of them puncticulate, others slightly puberulent; the beak short and entire.

Collected by Dr. Geo. G. Kennedy in a damp hollow near the Crawford Bridle Path, on Mt. Clinton, N. H., August 20, 1891.

Cryptogamic Notes from Long Island. III.

By Smith Ely Jelliffe, M. D.

Diatomaceae.

Amphora ovalis Kutz.
Cymbella Cistula Hempr.
Encyonema ventricosum Kutz.
Stauroneis acuta W. Sm.
Stauroneis anceps Ehrb.
Stauroneis gracilis Ehrb.
Stauroneis Phoenicenteron Ehrb.
Navicula Americana Ehrb.
Navicula ambigua Ehrb.
Navicula flamma A. Sch. var.
Navicula cuspidata Kutz.
Navicula dilatata Ehrb.
Navicula firma Kutz.
Navicula laevissima Kutz.
Navicula gibba (Kutz.) Ehrb.
Navicula Hitchcockii Ehrb.
Navicula apis Kutz.
Navicula lata Breb.
Navicula Lyra Ehrb.
Navicula major Kutz.
Navicula marina Ralfs.
Navicula radiosa Kutz.
Navicula rhyncocephala Kutz.
Navicula varians Greg.
Navicula viridis Kutz.
Pleurosigma angulatum W. Sm.
Pleurosigma Balticum W. Sm.
Pleurosigma elongatum W. Sm.
Pleurosigma Spencerii W. Sm.
Amphiprora ornata Bailey.
Gomphonema acuminatum Ehrb.
Gomphonema capitatum Ehrb.
Gomphonema constrictum Ehrb.
Rhoikosphenia curvata (Kutz.) Grun.
Achnanthes brevipes Ag.

Achnanthes longipes Ag.
Achnanthes subsessilis Ehrb.
Cocconeis Pedicularis Ehrb.
Cocconeis scutellum Ehrb.
Epithemia gibba (Ehrb.) Kutz.
Epithemia turgida (Ehrb.) Kutz.
Eunotia lunaris (Ehrb.) Grun.
Eunotia tridentula Ehrb.
Eunotia major (W. Sm.) Rab.
Synedra affinis Kutz.
Synedra fulgens (Kutz.) W. S.
Synedra pulchella Kutz.
Synedra longissima Kutz.
Synedra lanceolata Kutz.
Synedra Ulna (Nitzsch.) Ehrb.
Fragilaria capucina Desmaz.
Asterionella formosa Hass.
Meridion circulare Ag.
Tessela interrupta Ehrb. ?
Tabellaria fenestrata Kutz.
Tabellaria flocculosa (Roth.) Kutz.
Grammatophora marina Kutz.
Rhabdonema Adriaticum Kutz.
Cymatopleura elliptica (Breb.) W. Sm.
Cymatopleura Solea (Breb.) W. Sm.
Surirella elegans Ehrb.
Nitzschia fasciculata Grun.
Nitzschia gracilis Hautzsch.
Nitzschia scalaris (Ehrb.) W. Sm.
Nitzschia sigmoidea (Ehrb.) W. Sm,
Nitzschia tabellaria Grun.
Melosira Borrerii Grev.
Melosira granulata (Ehrb.) Ralfs.
Melosira varians Ag.
Biddulphia laevis Ehrb.
Biddulphia pulchella Gray.
Rhizosolenia gracilis H. L. S.
Triceratium alternans Bailey.
Eupodiscus radiatus Bailey.

Botanical Notes.

Hough's American Woods. Part VI. of this valuable series of thin sections of North American woods, together with the letter press to accompany Parts IV. and V., have recently been dis-

tributed to subscribers. The six parts now issued contain tangential, radial and transverse slices of 150 pieces of trees, and form an nvaluable part of the equipment of any botanical museum. Cross sections of these woods mounted as lantern slides are also prepared by Mr. Hough. Descriptive matter and specimens of the work may be obtained from him by addressing R. B. Hough, Lowville, N. Y.

Photographs of Fungi. We have received from Mr. C. G. Lloyd, of Cincinnati, the first set of a series of photographs and photogravures of the larger fungi, prepared by him for distribution among a limited number of students. The execution of these photographs is excellent and they cannot fail to be of great aid to mycologists. The species are determined by Mr. A. P. Morgan, of Preston, Ohio. Mr. Lloyd informs us that the sets are not for sale.

Reviews.

Guide to the Study of common Plants. An Introduction to Botany. V. M. Spaulding. 2nd edition, pp. 287. Boston, D. C. Heath & Co. 1895.

The second edition differs from the first mainly in the addition of a glossary and index of botanical terms, an index of plant names, and a chapter on fungi.

The text has undergone some alterations and a number of additions have been made to the reviews and summaries at the ends of chapters. The chapter on Fruits has been completed by a few pages on "The Organs of Flowerless Plants."

The chapters on ferns and club mosses have been simplified by the omission of the anatomy and developmental history, although the latter reappears in a review and summary of the Vascular Cryptogams. Many additions have been made to the "special studies," particularly in the portion of the book devoted to the families of flowering plants. E. A. S.

A preliminary List of the Mosses of Minnesota. John M. Holzinger. (Minn. Bot. Studies, Bull. No. 9, March 5th, 1895).

This list includes 156 species, arranged according to Renauld and Cardot's list, with the addition of one new variety, *Amblyodon dealbatus* var. *Americanus*, R. & C. ined., which has been distrib-

uted as No. 180 of their Musci. Am. bor. Exsicc., with description and notes in their observations. These specimens should be compared with *M. Macounii* Aust. which has been referred to *Amblyodan dealbatus* in the Manual. *Gymnostomum curvirostrum* var. *scabrum* is also an addition to the flora, not having previously been reported. We find several typographical errors, one of which is guilty of making a synomym for *Coscinodon Raui.* We have two sets of specimens from the Bluffs at Winona, and have not found *C. Wrightii* among them, but *C. Raui* does occur, and the fact that M. Cardot has determined it as *C. Renauldi,* adds another point to my argument that the species are identical.

The citation of authorities for *Cynodontium Wahlenbergii* (Brid.) Hartm. is incorrectly given, and *Physcomitrium pyriforme* is listed on Cardot's determination. We have not yet seen an American specimen which agreed with this species, and the ones sent to us by M. Cardot bearing this name are not excepted. *Physcomitrella patens* (Hedw.) Br. & Sch. should be added as having been collected by Miss Sheldon at Fort Snelling, Minn., October, 1894. E. G. B.

On new Species of Cretaceous Plants from Vancouver Island. J. W. Dawson. Trans. Roy. Soc Canada, sec. 4: 53–72. *pl. 5–14.* 1893.

In this paper are included descriptions of twenty-eight new species, some of which are, however, certainly referable to previously described species. The figures are poor and some of the material upon which new species are founded is too fragmentary to be satisfactory. In deference, doubtless, to certain critics of palaeobotany the author finds it advisable to use these words: "I think it proper to say that I cannot be expected to pledge myself for the accuracy of the generic names attached to mere leaves. When the fruit shall be found connected with them, they may require very different reference. At present they merely stand as forms of certain types characteristic of a certain geological age, and admitting of more or less accurate comparison with modern plants," which sentence he sums up quite concisely all that the palaeobotanists claims for his determinations. A chapter on the value of fossil plants as indices of climate in the past completes the paper. A. H.

Field, Forest and Garden Botany, by Asa Gray, revised and extended by L. H. Bailey.

This once popular little manual, first published in 1869, had never been revised nor re-edited by its author, and, in conseqence, had, in time, lost much of its value and become somewhat obsolete. Prof. C. R. Barnes began a much needed revision which was later taken up and has just been successfully carried through by Prof. Bailey. Considering the nature of the task it is doubtful whether anybody else was as well equipped for it.

The reviser states that his first aim was to preserve, as far as possible, the method of the original, attempting "nothing more than to bring it down to date." The work, however, has been more thorough and extensive than those words would imply; not only were the nomenclature and definition corrected, but the analytical keys and grouping of species into sections have been rearranged and much new matter added, so that the original of 374 pages has been increased to 503 pages. The added matter consists of no less than 82 genera and 533 species, the total number of species being 3203, of which 1784 are indigenous and 1419 extra-limital (in cultivation). To give a few examples taken at random: *Clematis* has now 17 described species instead of 11 in the original; *Magnolia*, 8 species and hybrids instead of 3; *Brassica*, 8 instead of 5; *Tilia*, 6 instead of 3; *Prunus*, 29 instead of 19; *Pyrus*, 16 instead of 10; *Canna*, 11 instead of 5; Palms, 17 instead of 4, &c., and the quality has kept pace with the quantity. The typography is also very much improved, being even better than that of Gray's Manual, and, indeed, about as perfect as one could desire.

This book is intended to remain, as before, a companion to the Manual, and the nomenclature and definition are made to conform strictly with it; whatever shortcomings, therefore, the Manual is guilty of in these respects are shared by its companion work. A very welcome innovation is the citation of the authority after each name; this, in our day, has become a necessity in a work with any pretention to exactness.

As would be expected, special attention was devoted to cultivated plants, whether ornamental or useful, native or introduced; in this respect the revision is remarkably complete, including even

such comparatively recent introductions as *Akebia quinata*, *Actinidia polygama*, *Solanum muricatum*, etc. It is not only the best, but, I may say, the only work descriptive of our domesticated flora. It will be heartily welcome by the many who have neither time nor facilities for the pure study of systematic botany, but who, nevertheless, love flowers and takes an intelligent interest in the wealth of decorative and useful plants which surround them on on all sides. V. H.

Pflanzenkrankheiten durch kryptogamen Parasiten verursacht Karl Freiherr von Tubeuf. Berlin, 1895.

This book is a condensed treatise on plant "parasitism" or "symbiosis" in its widest sense. Unfortunately the term plant-disease (Pflanzenkrankheit) is not defined, but the reader is led to assume that any change produced in a plant due to a "symbiotic" or "parasitic" relation with another plant is considered a plant disease.

The attempt is made to treat the physiological and morphological relations of parasitism from a comparative standpoint. Physiological and anatomical details are not entered into as that would be both impossible and unnecessary because of the copious citations of special authors whom the specialist interested may consult. All the authorites quoted are recent and standard. With few exceptions the figures are excellent. The numerous photographs are especially interesting.

The student of general botany will no doubt find Part I. the most interesting. Here the author has very briefly outlined his conception of parasitism in the wider sense. Here he also shows his greatest originality. Especially interesting are his distinctions between *Mutualism* ("Mutualismus") and *Nutricism* ("Nutricismus"). By the former is meant that form of parasitism in which the two symbionts mutually benefit each other. As the most important examples are to be mentioned the lichens. Here two organisms, an alga and a fungus live together for mutual benefit. He emphasizes the fact that this symbiosis has so changed the life history of the two organisms that they combine to form a *new* organism. This union of two originally distinct organisms to form an independent organism he designates "*individualism*." By nutricism is meant that form of parasitism in which one of the

symbionts is not benefited because no assistance is required. As an example may be mentioned the *mycorhiza* of certain trees and the *mycodomatiae* (rhizobia) of Leguminosae. Here the author supposes that the infecting fungus works in the interest of the plant infected without receiving any benefit in return.

In Part I. are also given various approved methods and means for guarding against infection of pernicious parasites and how to to destroy them after infection has taken place.

Part II., which is by far the most extensive, treats of "phytopathogenic fungi and algae." It is essentially a systematic description of the infecting fungi and algae based upon the most recent investigations and conclusions.

Taken all in all, this work is certainly a most valuable contribution to the science of botany. It will prove of great benefit to all botanists. The condensed retrospect of the subject will suffice for the general student, while the citations will be found very useful by the special student.

Language and style are scientifically clear and simple. Only a a few of the figures are borrowed. ALBERT SCHNEIDER.

A Monograph of the North American Species of the Genus Polygonum, by John Kunkel Small. This work, a folio of 183 pages (not counting the plates), was issued on the 23d of April, 1895, as the first volume of Memoirs from the Department of Botany of Columbia College.

In the introduction, after discussing the position of the family to which it has given a name, the relation of the genus *Polygonum* to its allies is taken up and considered. Then follow chapters on the geographical distribution of the species, the general morphology of the genus, the anatomy of the stem and general anatomy.

Natural and distinct as the genus appears, it admits of division into well-marked sub-genera, nine of which contain representatives in the New World, viz.: Bistorta, Aconogonon, Persicaria, Amblyogon, Tovaria, Avicularia, Duravia, Tiniaria and Echinocaulon. These, as described and figured by Dr. Small, including a fossil species from the Miocene Tertiary of Colorado, number 71. Each of them is illustrated by an uncolored outline-drawing on a separate sheet, so admirably executed as to make the salient charac-

ters clear to the eye, and the descriptions on the opposite pages are models for their terse and accurate use of botanical terminology.

The new species, 9 in all and the varieties 8, form a large addition to the genus.

The latter part of the volume is devoted to the comparative anatomy of the stems of certain species, accompanied by 15 excellent plates, which exhibit such diversities of internal structure as to afford essential aid in support of sub-generic and even specific distinctions.

To withhold recognition, so fairly earned and so worthy of acknowledgment, from a work like this would be wrong. It is highly creditable both to the author and to the college whose ample resources and friendly help enabled him to produce it. The fruit, not of a hasty and rapid incursion, but of persistent, patient and thorough study of the field which it covers, the contribution it has made to science is solid and will endure. What Dr. Engelmann did for *Juncus* has now been done for *Polygonum*, and more of just this kind of labor is needed for the better elucidation of our North American Flora. T. C. P.

Proceedings of the Club.

TUESDAY EVENING, MAY 14TH, 1895.

The President in the chair and 22 persons present.

Mr. A. Ruth and Mr. W. A. Bastedo were elected active members.

The editor announced the publication of the third part of Vol. 4 of the MEMOIRS, and stated that the fourth part would contain a paper by Mrs. Pettit on *Arachis hypogaea*.

Mr. Lighthipe reported excellent progress in the rearrangement of the herbarium.

The announced papers of the evening were then presented.

1. By Mr. George V. Nash, "The North American Species of the Genus *Cenchrus*," illustrated by specimens.

2. By Mrs. Anna S. Pettit, "Notes from a Study of the Peanut, *Arachis hypogaea*."

Dr. N. L. Britton exhibited a series of lantern-slides of cross-sections of North American Woods, prepared by Mr. R. B. Hough.

WEDNESDAY EVENING, MAY 29TH, 1895.

Vice-President Lighthipe in the chair and 32 persons present.

Miss Rose T. Roux, Mr. James A. Graves and Mr. Frederick King Vreeland were elected active members.

Mr. Barnhart reported the occurrence of *Azalea lutea* L. (*A. calendulacea* Michx.) in an apparently native state near Tarrytown, N. Y., and remarked on the distribution of this species, which is not recorded in recent writings from further northeast than the mountains of Pennsylvania. Dr. Britton called the attention of the Club to the recorded occurrence of a yellow-flowered *Azalea* in southern New York by Governor Cadwallader Colden about the middle of the last century, and that Colden's account of it had been made a part of the citations by Linnaeus of his *Azalea lutea* in 1753. Linnaeus later abandoned the name *lutea* on account of having received specimens of the pink-flowered species which he described as *A. nudiflora* in 1762, supposing them to be the same. Mr. Barnhart's discovery is an interesting confirmation of the position taken in the recently issued "List of Northeastern North American Plants" that the name *A. lutea* L. must replace *A. calendulacea* Michx.

Mr. Barnhart also reported that *Aliiaria Alliaria*, found by him last year at Hastings, N. Y., had this year spread over a considerable area and was well established.

The announced paper of the evening was read by Mr. A. A. Tyler on "Stipules in the Family Rosaceae," illustrated by specimens and drawings. It was discussed by Dr. Schneider and Dr. Britton.

The Club then adjourned to the second Tuesday evening in October.

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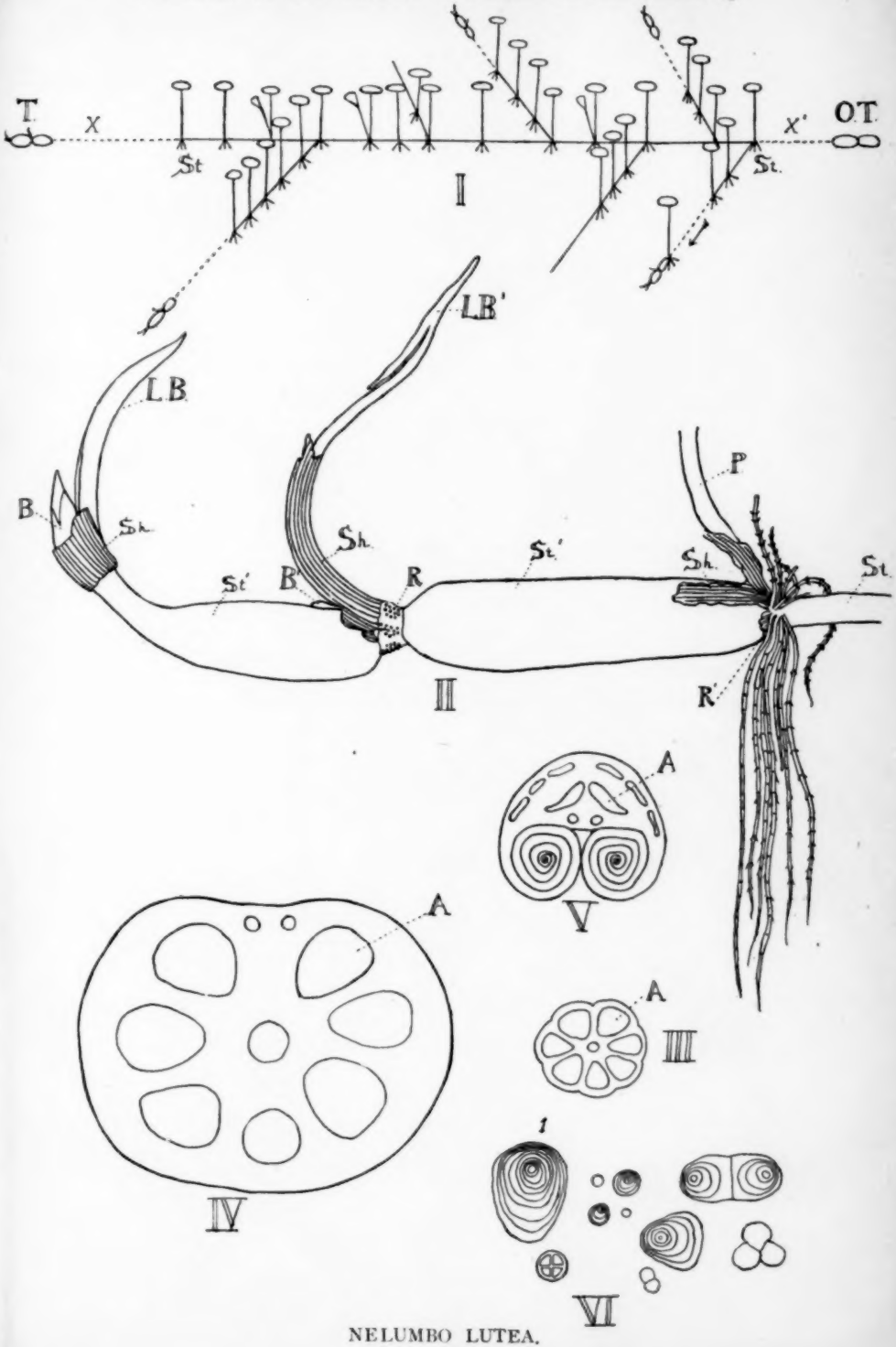

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